

REMARKS

Favorable consideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 7-12 are pending in the application, with Claims 1-6 having been cancelled and Claims 7-12 having been added by way of the present amendment.

In the outstanding Office Action dated September 23, 2002, the abstract was noted as missing; Claim 1 was rejected under 35 U.S.C. § 102(b) as being anticipated by Wagner (U.S. Patent No. 4,057,7125) or Takihashi et al. (U.S. Patent No. 5,164,973); Claims 1, 3, and 4 were rejected under 35 U.S.C. § 102(b) as being anticipated by Shaw et al. (U.S. Patent No. 4,338,521); and Claims 2, 5, and 6 were rejected under 35 U.S.C. § 103 as being unpatentable over Shaw.

Applicants appreciate the telephone interviews between the Examiner and Applicants' representative on February 12 and 13, 2003. During these telephone interviews, the Examiner reported that he was able to locate the abstract and indicated that a new abstract was no longer required. Also during these interviews, the Examiner noted that his file was missing numbered page 11 (containing Claims 3-6) but that he had separate pages with Claims 1-6 listed. To prevent confusion, the Examiner recommended that Claims 1-6 be cancelled and replaced with new claims directed to the invention Applicants desired to be examined. The Examiner also indicated he would place an interview summary sheet in the record relative to these telephone interviews.

Pending Claims 7-12 correspond to cancelled Claims 1-6, respectively, with Claims 7 and 12 including the feature that detector modules are arranged in the shape of a contiguous polygon and arranged detector modules are placed opposite a single, non-rotating emitter.

Support for these features is found in Applicants' originally filed specification.¹ No new matter is added.

Briefly recapitulating, new Claim 7 recites a semiconductor detector for use in a high-speed X-ray CT. The detector comprises a plurality of detector modules, each comprising a plurality of X-ray detection pixels arranged unidirectionally on a single planar semiconductor substrate. The plurality of detector modules are arranged around a measuring area in the shape of a contiguous polygon which is placed opposite a single, non-rotating emitter. With the detection pixels arranged uni-directionally on a single planar semiconductor substrate, it is unnecessary to discretely arrange detection pixels thereby a less complicated and expensive manufacturing is required.²

Wagner et al. discloses a device for measuring radiation absorption in a body.³ The device of Wagner includes a plurality of detector modules arranged in the shape of a polygon.⁴ The device of Wagner also includes a plurality of X-ray or gamma ray emitters with each of the emitters positioned between each detector modules.⁵ Wagner does not teach or suggest a semiconductor detector formed by arranging the plurality of said detector modules around a measuring area in the shape of a contiguous polygon. Wagner also does not teach or suggest a semiconductor detector that is placed opposite a single, non-rotating emitter at such a distance so as to ensure full-object irradiation. The non-contiguous polygon detector, multi-emitter device of Wagner does not allow for even spatial sampling data as is possible with the contiguous polygon detector, single emitter of new Claim 7. Thus, the non-contiguous polygon detector, multi-emitter device of Wagner is prone to errors of image restructuring in CT laminagraphy that are not present in structure recited in new Claim 7. In

¹ Specification, Figure 2.

² Specification, page 5, lines 6-12.

³ Wagner, column 1, lines 1-10.

⁴ Wagner, column 1, Figure 2.

addition, the positioning of an emitter between two detector elements in Wagner causes reduced detector sensitivity, reliability, and longevity. The invention recited in new Claim 7 does not suffer from these limitations because the semiconductor detector comprises contiguous detectors that are placed opposite a single, non-rotating emitter and thus is not subjected to radiation from adjacent emitters. For at least these reasons, Applicants submit that the invention recited in Claims 7 and 12, and all claims dependent therefrom, patentably defines over Wagner.

Takahashi et al. discloses a projection detecting apparatus for computer tomography.⁶ The device of Takahashi includes a contiguous detector and a single, rotatable emitter that are jointly rotated around the object to be inspected.⁷ Takahashi also does not teach or suggest a semiconductor detector that is placed opposite a single, non-rotating emitter. The contiguous polygon detector, multi-emitter device of Takahashi is placed so close to the object to be inspected that the emitted radiation only passes through a small part of the measuring area. To obtain CT cross sectional image of an entire object, the emitter and the polygon detector module of Takahashi must be mechanically rotated around the measuring area. In the invention recited in new Claim 7, however, rotation is not required to obtain a cross-sectional image thereby allowing for a less complex and less expensive device. Also, a rotatable assembly is prone to movement induced errors not present in Applicants' claimed invention.⁸ For at least these reasons, Applicants submit that the inventions recited in Claims 7 and 12, and all claims dependent therefrom, patentably define over Takahashi.

Furthermore, Takahashi discloses a structure in which each pixel is constituted by

⁵ Wagner, column 1, Figure 2.

⁶ Takahashi, column 2, lines 28-34.

⁷ Takahashi, Figure 2.

⁸ Specification, page 3, lines 3-9.

individual scintillator and photodiode.⁹ Takahashi does not disclose a structure in which a plurality of X-ray detection pixels are arranged unidirectionally on a single planar semiconductor substrate as recited in Claim 7. With pixels arranged on a sheet of consecutive compound semiconductor by means of photolithography, the present invention provides superior resolution.¹⁰ The invention disclosed by Takahashi does not include pixels arranged unidirectionally on a single planar semiconductor substrate and, thus, does not achieve this same level of resolution. Thus, for another reason, Applicants submit that the inventions recited in Claims 7 and 12, and all claims dependent therefrom, patentably define over Takahashi.

Shaw et al. discloses a rotatable tomographic apparatus including a modular detection array.¹¹ Contrary to the assertion in the Office Action, Shaw does not disclose a semiconductor detector.¹² In fact, Shaw makes no reference to any shape, let alone a polygon when describing the modular detector.¹³ However, by inspection it is apparent that the modular detector of Shaw is arranged in an arc, not a polygon.¹⁴ Furthermore, Shaw does not disclose a detector array placed opposite a single, non-rotating emitter. Instead, the assembly of Shaw is rotatable and, therefore, is prone to the same movement induced errors of Takahashi. For at least these reasons, Applicants submit that the inventions recited in Claims 7 and 12, and all claims dependent therefrom, patentably define over Shaw.

In addition, Applicants note that neither Wagner, Takahashi, or Shaw, individually or in combination, teach or suggest all the elements of Claim 7 or Claim 12. Therefore, Applicants submit the inventions defined by Claims 7 and 12, and all claims depending

⁹ Takahashi, Figure 3.

¹⁰ Specification, page 9, lines 9-14.

¹¹ Shaw, column 2, lines 44-56 and Figure 1.

¹² Office Action, page 2, lines 15-20.

¹³ Shaw, column 3, lines 6-18.

¹⁴ Shaw, Figure 3

therefrom, are not rendered obvious by the asserted prior art for at least the reasons stated above.¹⁵ Furthermore, Applicants submit there is no teaching, suggestion, or motivation, either explicitly or implicitly, in any of references to combine features found in the other references to arrive at Applicants' inventions recited in Claims 7-12. Thus, Applicants submit it would only be through an impermissible hindsight reconstruction of Applicants' invention that a rejection of Claims 7-12 based on these references could be understood.¹⁶

Regarding the rejection of Claims 2, 5, and 6 under 35 U.S.C. § 103 in view Shaw et al., Applicants submit that Shaw does not teach or suggest a semiconductor detector arranged opposite a single, non-rotatably emitter and, therefore, traverse for at least the reasons noted above.¹⁷ Applicants also note that Shaw teaches an array detector comprising scintillator and photodiode.¹⁸ Applicants submit that Shaw does not teach or suggest a detector array comprising a compound semiconductor such as CdTe as recited in new Claim 8. By using a compound semiconductor array such as CdTe in the invention recited in Claim 8, X-rays or gamma rays are converted into an electric signal directly, thus negating the need for a photodiode. Applicants also submit that the present invention distinguishes from Shaw in that Shaw discloses a pixel comprising an individual scintillator.¹⁹ In the present invention, creation of pixels by means of photolithography makes it possible to greatly reduce pixel

¹⁵ MPEP § 2142 "...the prior art reference (or references when combined) must teach or suggest **all** the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. In re Vaack, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)."

¹⁶ MPEP § 2143.01 "Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge of one of ordinary skill in the art."

¹⁷ MPEP § 2142 "...the prior art reference (or references when combined) must teach or suggest **all** the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. In re Vaack, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)."

¹⁸ Shaw, Figure 8.

¹⁹ Shaw, Figure 8.

sizes so as to enhance resolution.²⁰ Such a technique can not be anticipated from the description of Shaw. Thus, Applicants submit that the invention of Claims 2 and 6, and all Claims depending therefrom, are not rendered obvious by Shaw.

Furthermore, the photodiode Shaw serves to convert a received X-ray into an electric signal.²¹ This photodiode is mounted on the printed circuit substrate.²² In the present invention, a plurality of X-ray detection pixels 4 are formed directly on a semiconductor substrate 3 by photolithography. An integrated circuit 5 is connected to each of the pixels 4 by wiring 6.²³ The integrated circuit 5 is used to amplify analog electric signal generated in the compound semiconductor (CdTe) pixel. The use of compound semiconductor (CdTe) pixel and a pre-amplifier is located just behind the compound semiconductor pixels and serves to reduce noise and allow for component miniaturization. Shaw does not disclose or suggest use of either compound semiconductor (CdTe) pixel or a pre-amplifier and, for another reason, does not render the invention recited in Claims 7-12 obvious.

Furthermore, Applicants respectfully traverse the implication in the Office Action that photolithography for the creation of printed circuit boards is equivalent to photolithography for the creation of detector pixels.²⁴ While technique of photolithography for wiring of printed circuit board has been established, special techniques are required for machining on a compound semiconductor such as CdTe. Shaw does not teach or suggest creating detectors by photolithography

²⁰ Specification, page 4, lines 20-25 and page 7, lines 13-18

²¹ Shaw, column 4, lines 43-50.

²² Shaw, Figure 8.

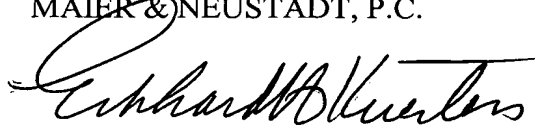
²³ Specification, page 6, line 25 – page 7, line 7 and Figure 1.

²⁴ Official Action, page 3, lines 10-12.

Accordingly, in view of the present amendment and in light of the previous discussion, it is respectfully submitted that the application is believed in condition for allowance and early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Claims 1-6 (Cancelled).

Claims 7-12 (New).